Original article

Awareness, Risk Perception of health effects of global warming among high school students in Bangkok

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Abstract

Global warming has significant health impacts, including heat-related illnesses, respiratory conditions, and the spread of vector-borne diseases. Understanding and addressing youth awareness and risk perception is essential, as young people are both vulnerable to these impacts and key agents of change. This study aimed to assess awareness and risk perception regarding the health effects of global warming among high school students in Bangkok and to identify significant predictors influencing their risk perception.

A cross-sectional survey was conducted between August 12 and September 27, 2024, using a validated questionnaire. A total of 363 high school students participated, and their responses were analyzed using descriptive and inferential statistics, including linear regression analysis. The results showed that 81.82% of students demonstrated a good level of knowledge about the health effects of global warming, but 62.53% had difficulty understanding its indirect impacts, such as the spread of mosquito-borne diseases. Overall, 51.24% of participants exhibited a high level of risk perception, 41.05% had a moderate level, and 7.71% had a low level.

Regression analysis identified knowledge as the strongest predictor of risk perception ($B = 0.238$, $p < 0.001$), explaining approximately 23.8% of the variance. Other significant predictors included gender (15.2% influence, $p < 0.01$), class level (10.7%, $p < 0.01$), household income (17.1%, $p < 0.01$), and participation in environmental activities (10.2%, $p < 0.05$).

These findings underscore the need for targeted educational interventions that address demographic differences, integrate comprehensive climate and health education into school curricula, and promote experiential learning opportunities. Enhancing youth awareness and fostering proactive behaviors are crucial to equipping them with the knowledge and skills necessary to mitigate and adapt to the health effects of global warming.

Keywords: Global warming, health impacts, awareness, risk perception, high school students, Bangkok

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Introduction

Global warming, marked by a sustained rise in global temperatures, transcends environmental concerns to emerge as a critical public health crisis. Over the past century, global temperatures have increased by approximately 1.2 degrees Celsius, triggering profound climate and ecological changes that significantly impact human health (Health Systems Research Institute (HSRI), 2009; The Intergovernmental Panel on Climate Change, 2024; World Health Organization, 2023). These climate shifts contribute to heat-related illnesses, respiratory diseases, and the spread of vector-borne infections, posing direct and indirect threats to public health.

In Bangkok, a densely populated urban center, the effects of global warming are becoming increasingly evident. The city faces rising temperatures, deteriorating air quality, and increasing frequency of extreme weather events, all of which exacerbate health risks. Studies have reported that urban heat island effects in Bangkok result in significantly higher temperatures compared to rural areas, leading to increased cases of heat exhaustion and heatstroke, particularly among youth and vulnerable populations. Furthermore, air pollution, a known consequence of climate change, has been linked to rising rates of respiratory illnesses, such as asthma and chronic obstructive pulmonary disease (COPD), among school-aged children. Additionally, the prevalence of mosquito-borne diseases, such as dengue fever, has surged in Bangkok due to prolonged rainy seasons and elevated humidity levels, which create ideal breeding conditions for disease vectors.

Despite these pressing health concerns, awareness and understanding of the health implications of global warming among Bangkok's youth remain inconsistent. Previous research suggests that while students recognize climate change as a serious environmental issue, many fail to fully grasp its direct and indirect health consequences. For instance, a preliminary assessment indicates that over 60% of students struggle with understanding how climate change influences the spread of infectious diseases, and a significant portion exhibits low risk perception regarding personal vulnerability to climate-related health effects. This gap in awareness and risk perception underscores the urgent need for targeted climate-health education programs to equip young individuals with the knowledge and skills to mitigate and adapt to the changing environment.

The Role of Youth in Climate Resilience As youth represent a crucial demographic in shaping future policies and behaviors, it is essential to enhance their engagement in climate education initiatives. Recent studies emphasize that students who receive structured environmental education are more likely to adopt pro-environmental behaviors and develop a stronger sense of climate responsibility (Zhang et al., 2022). However, educational gaps persist, particularly in integrating health-specific climate knowledge into school curricula. To effectively address this issue, educational interventions must go beyond general climate awareness and focus on concrete health risks, adaptation strategies, and proactive measures.

This study specifically aims to assess awareness and risk perception regarding the health effects of global warming among high school students in Bangkok. Using the Knowledge-Attitude-Practice (KAP) framework, the research will explore how students' understanding translates into perceived risks and preparedness (Alsaleh, F. M., et al., 2023). By identifying key predictive factors influencing risk perception, this study provides critical insights for targeted interventions and educational strategies that can empower students to make informed decisions regarding climate-related health risks.

Objectives

To evaluate the level of awareness among high school students in Bangkok regarding the health effects of global warming.

To determine students' perception of risks related to the health impacts of global warming.

To identify and analyze factors that influence students' risk perception, including demographic, socioeconomic, and educational variables.

Study Methods

The sample size was determined using Cochran's formula, resulting in a required sample of 356 students. There were 363 volunteers to participate in this study, therefore in this study we used 363 samples.

Population and Sampling

The target population for this study consisted of high school students in Bangkok who have internet access, considered as an infinite population. The sample size was determined using Cochran's formula, resulting in a required sample of 356 students. There were 363 volunteers to participate in this study, therefore in this study we used 363 samples.

Instrument

The research tool was developed through a systematic process. First, a comprehensive review of literature on global warming, its health effects, and relevant academic studies from the past five years was conducted.

The survey instrument was then validated by experts from three fields: Environmental Science, Medical Science, and Health Science Research, with an Item-Objective Congruence (IOC) score 1.0 and 1.0. and the Cronbach's Alpha value was 0.85, reflecting high reliability. Following expert validation, the tool underwent pilot testing with 30 high school students to assess its difficulty level, with the results indicating no modification. The final version of the questionnaire contained 33 questions; 8 personal data (gender, class level, living area, living condition, parent's education, household income, health condition, and no. of participation in environmental activity) and 25 items divided into 2 sections.

The knowledge assessment on the health effects of global warming consists of 15 multiple-choice questions. Each question has four answer options, with only one correct answer. The total score will be calculated based on the number of correct responses, with a possible score range from 0 to 15. The score interpretation is as follows: (Table 1)

Question assessing risk perception of health effects from global warming consists of 10 questions, and the response categories consisted of a five-point Likert scale (from 1–strongly disagree to 5–agree), with the highest score corresponding to more positive attitudes toward preventive behaviors. Some items on

the scale were inverted for the analysis. The total score will be calculated based on the number of correct responses, with a possible score range from 10 to 50. The score interpretation is as follows: (Table 2)

Data analysis

The personal data of the sample group will be analyzed using descriptive statistics, including frequency (number), percentage, mean, and standard deviation (S.D.). In addition, inferential statistics will be used to analyze the predictive factors for risk perception, determining the relationships between variables.

Ethical Consideration

This study ensured ethical standards by obtaining informed consent from all participants, and they were provided with clear information about the study's objectives, procedures, and potential risks. Participation is entirely voluntary, and participants have the right to withdraw from the study at any time without any consequences. All personal information collected will remain confidential and will be anonymized to protect the identity of the respondents. Data will be securely stored and used solely for the purposes of this research.

Results

A total of 416 participants were included in the study. Among them, 161 (44.35%) were male, and 202 (55.65%) were female. Regarding education level, 88 participants (24.24%) were in Grade 10, 146 (40.22%) in Grade 11, 95 (26.17%) in Grade 12, and 34 (9.37%) were university students.

In terms of living conditions, the majority of participants, 311 (85.68%), lived with their parents, while smaller numbers lived with relatives (13, 3.58%), friends (13, 3.58%), or alone (26, 7.16%).

The highest education level of participants' parents was predominantly a bachelor's degree (127, 34.99%), followed by a master's degree (108, 29.75%), high school (98, 27.00%), and higher than a master's degree (30, 8.26%).

Household income ranged from less than 20,000 baht for 67 participants (18.46%) to over 150,000 baht for 97 participants (26.72%).

Regarding health conditions, 303 participants (72.8%) reported no chronic health conditions, while 60 (14.4%) reported having chronic conditions.

Environmental activity participation varied, with 117 participants (32.23%) reporting no participation, 197 (54.27%) reporting less than three activities annually, and 49 (13.50%) participating in more than three activities per year. (Table 3)

A majority of the participants, 297 (81.8%), scored between 12-15, indicating a good level of knowledge regarding health effects of global warming. Additionally, 33 participants (9.09%) had scores ranging from 9-11, reflecting a moderate level of knowledge, while 33 participants (9.09%) scored below 9, indicating a low level of knowledge. (Table 4)

From the assessment on knowledge regarding health effects of global warming, the results showed that the top three most correctly answered questions highlight strong awareness among students regarding the health effects of global warming. The highest correct response rate was for the question about how global warming worsens respiratory conditions, with 93.66% of students answering correctly. This was followed by questions on how increased heat affects human health and how global warming impacts air quality, both with 91.46% correct answers. On the other hand, the least correctly answered question, with only 62.53% correct, was about how climate change affects the spread of mosquito-borne diseases. The second-lowest was related to the contribution of agriculture and livestock farming to global warming (73.00%), and the third was about health issues linked to global warming, with 80.17% correct answers. These results suggest that while students are well-informed about direct health impacts, there is less understanding of more complex or indirect consequences of global warming. (Graph 1)

Of the participants, 186 (51.24%) demonstrated a high level of risk perception regarding health effects of global warming with scores between 40-50. A further 149 participants (41.05%) had a moderate level of perception, scoring between 30-39, while 28 participants (7.71%) scored below 30, indicating a low level of risk perception regarding health effects of global warming. (Table 5)

From the risk perception of health effects of global warming assessment, the results showed that the top three issues with the highest "Very High" risk perception are the belief that future generations will face more severe health issues from global warming (59.50%), the concern that government and health organizations are not doing enough to address these health risks (50.14%), and the fear of increasing respiratory problems caused by worsening air pollution (44.63%). On the other hand, the three issues with the lowest "Very High" risk perception are feeling vulnerable to health impacts in their local area (28.37%), the link between global warming and mental health issues such as anxiety and stress (33.88%), and the visibility of health impacts in some residential communities (33.88%). These results highlight stronger concerns about future impacts and institutional response compared to personal vulnerability or mental health effects. (Graph 2.)

The linear regression analysis identified five significant predictors of risk perception regarding the health effects of global warming. Knowledge ($B = 0.238$, $p < 0.001$) was the strongest predictor, showing a clear link between higher knowledge and greater perceived risk. Gender (Beta = 0.152, $p < 0.01$) and class level ($B = 0.107$, $p < 0.01$) indicated that females and older students are more aware of risks. Household income ($B = 0.171$, $p < 0.01$) correlated positively, likely due to better access to resources, while participation in environmental activities ($B = 0.102$, $p < 0.05$) highlighted the role of experiential learning. These results emphasize the influence of knowledge, demographics, and engagement on shaping risk perception. (Table 4)

Discussion

The findings of this study reveal important insights into the awareness and risk perception of high school students in Bangkok regarding the health effects of global warming. These results provide a solid foundation for developing targeted educational interventions aimed at addressing gaps in understanding and enhancing youth engagement with climate change issues.

Awareness of Health Effects of Global Warming

A significant majority (81.82%) of participants demonstrated a good level of awareness about the health effects of global warming, highlighting the general efficacy of existing educational efforts. The level of awareness of health effect of global warming of this study align with a study conducted in Spain by Raquel de Rivas (de Rivas, R., et al. 2024). which showed that the participating students are concerned about socio-environmental problems, particularly about Climate Change. Moreover, the participating students are concerned about socio-environmental problems, particularly climate change, due to their awareness of the significant impact these issues have on society and the environment. The study highlights that while students exhibit a limited understanding of sustainability, they recognize the urgency of addressing the planetary crisis caused by climate change. This concern likely stems from their exposure to discussions about the adverse effects of climate change and socio-environmental challenges, as well as their sense of responsibility toward ensuring a sustainable future. A study conducted in Australia by Claudia Bladwin et al, 2022 about Knowledge and self-efficacy of youth to take action on climate change revealed that participants reported a high level of understanding of impacts, they had significant knowledge gaps regarding the most effective measures to mitigate climate change.

The study by Rosidin & Suyatna (2017) found that junior high school students had significant gaps between knowledge and attitudes regarding global warming, likely due to curriculum limitations. Our study, focusing on high school students, found a higher level of awareness (81.82%) and identified class level as a predictor of risk perception. This suggests that educational progression improves knowledge, but challenges remain in ensuring that knowledge translates into heightened risk perception. Like the Indonesian study, our findings highlight the need for more effective climate-health education strategies to bridge the gap between awareness and perception.

Risk Perception of Health Effects of Global Warming

The finding that 51.24% of participants exhibited a high level of risk perception regarding the health effects of global warming underscores the need to enhance students' awareness and foster a deeper sense of personal vulnerability. This result is consistent with global studies showing that while young people are highly concerned about climate change, their risk perception often emphasizes broader societal or generational impacts rather than immediate or localized threats. For instance, research by the British Council highlights that climate change consistently ranks among the top concerns for youth worldwide due to its long-term implications for future generations and global systems (British Council, 2023).

Findings from Albania further illustrate the progression of climate-related concerns among young people, evolving from immediate environmental observations in children to a more nuanced understanding of systemic and health impacts among adolescents and young adults. This progression highlights the critical importance of age-appropriate educational interventions that build on these developmental stages to foster actionable risk perceptions and promote climate resilience (World Vision Albania, 2023). Additionally, studies such as one from Harvard University reveal the profound mental health impacts of climate change on young people, with many experiencing anxiety-related symptoms like panic attacks, insomnia, obsessive thinking, and feelings of helplessness due to concerns about future climate threats (The President and Fellows of Harvard College, 2023). This finding underscores the importance of incorporating mental health considerations into climate education, addressing not only the knowledge gaps but also the emotional and psychological challenges associated with climate-related fears.

Predictors of Risk Perception

The identification of five significant predictors of risk perception regarding the health effects of global warming underscores the multifaceted factors shaping students' awareness. Among these, knowledge emerged as the strongest predictor ($B = 0.238$, $p < 0.001$), explaining 23.8% of the variance, confirming the pivotal role of education in fostering a deeper understanding of climate-related health risks. This finding aligns with global research, which consistently shows that informed individuals are more likely to recognize and respond to environmental challenges. However, unlike studies from the UK (British Council, 2023) and Spain (de Rivas et al., 2024)-where media exposure and social norms played a more dominant role-this study suggests that in Bangkok, formal education is the primary driver of climate risk awareness. This highlights the importance of integrating climate-health education into school curricula, ensuring students develop a deeper and evidence-based understanding of the health impacts of global warming.

Household income ($B = 0.171$, $p < 0.01$) was another significant predictor, suggesting that socioeconomic status influences risk perception. Unlike research conducted in Australia (Baldwin et al., 2022) and other developed countries, where income had minimal influence, this study found that higher-income students exhibited greater awareness and concern. A possible explanation is that higher-income students have greater access to environmental education, extracurricular activities, and global news coverage, which reinforces their understanding of climate risks. Conversely, lower-income students may prioritize immediate social and economic concerns over climate-related risks, leading to lower perceived vulnerability. This finding highlights the need for equitable access to climate education across different socioeconomic groups in Bangkok to bridge knowledge gaps. Gender ($B = 0.152$, $p < 0.01$) and class level ($B = 0.107$, $p < 0.01$) were also significant predictors. Female students demonstrated greater concern about the health effects of global warming than males, a trend that has been observed in Australia (Baldwin et al., 2022) and Albania (World Vision, 2023), where women generally exhibit higher environmental awareness. However, this contrasts with research in Indonesia (Rosidin & Suyatna, 2017), where gender differences in climate risk perception were minimal. The discrepancy may be due to cultural factors and gendered socialization patterns in Thailand, where environmental issues and health-related concerns are often framed as more relevant to women. Similarly, older students exhibited higher levels of risk perception, likely due to their greater cognitive maturity and exposure to climate education in

later school years. These findings suggest that climate education initiatives should be tailored to different age groups and incorporate strategies to engage both male and female students effectively.

Participation in environmental activities (B = 0.102, p < 0.05) further emphasized the value of experiential learning in fostering risk perception. Hands-on involvement in activities such as community clean-ups, tree planting, and climate-related volunteer projects likely strengthens students' connection to environmental issues, making abstract concepts more tangible. This aligns with existing evidence that active engagement enhances environmental knowledge and personal responsibility. However, this study found a stronger link between participation and risk perception than prior research from the UK (British Council, 2023), which reported little correlation between environmental program participation and risk perception. The difference may stem from the nature of environmental education in Bangkok, where direct engagement with activities may provide students with clearer insights into climate-related health risks.

These findings suggest that climate education in Bangkok should prioritize knowledge-based learning, as formal education plays a crucial role in shaping students' climate risk perception. Since students from higher-income families have greater access to environmental education and awareness programs, it is essential to develop targeted interventions for lower-income students to bridge educational access gaps. Additionally, given the significant impact of experiential learning, expanding environmental activity programs-such as community clean-ups, tree planting, and climate advocacy projects-could further enhance students' ability to connect theoretical knowledge with real-world implications. Furthermore, gender-based engagement strategies should be implemented to ensure that climate education programs effectively reach both male and female students while addressing their differing perspectives on climate risk.

Limitation

This study has several limitations that should be considered when interpreting the results. First, the cross-sectional design only provides a snapshot of awareness and risk perception at a specific point in time, limiting the ability to infer causality. Second, the study sample was limited to high school students in Bangkok, which may not represent the broader population of Thai youth, particularly those in rural or underprivileged areas. Third, data collection relied on self-reported responses, which may be subject to social desirability bias or inaccuracies in recall. Lastly, while the survey was validated and pilot-tested, additional qualitative methods, such as interviews or focus groups, could have provided deeper insights into students' perceptions and attitudes.

Conclusion

This study emphasizes the awareness and risk perception of high school students in Bangkok regarding the health effects of global warming, providing critical insights into factors shaping their understanding. While most students demonstrated a good level of knowledge, gaps remain in understanding indirect health impacts, such as the spread of mosquito-borne diseases. Risk perception was moderate to high, with stronger concerns about future impacts and institutional responses than personal vulnerability.

The regression analysis identified knowledge as the strongest predictor of risk perception, emphasizing the importance of education in fostering climate awareness. Other significant factors included gender, class level, household income, and participation in environmental activities, highlighting the roles of demographic and experiential variables. These findings underscore the need for targeted educational strategies that integrate knowledge dissemination, demographic inclusivity, and experiential learning to enhance students' ability to recognize and respond to the health challenges posed by global warming. This approach is vital for equipping young people to act as informed agents of change in addressing the climate crisis.

To address the findings of this research, it is recommended that climate and health education be integrated into school curricula, focusing on both direct and indirect health impacts of global warming. Experiential learning opportunities, such as environmental activities, should be promoted to enhance students' engagement and understanding. Tailored interventions that address demographic differences, such as age, gender, and socioeconomic background, are essential to maximize their impact. Additionally, educational resources must be made accessible to students from all income levels to bridge knowledge gaps. Mental health support should be incorporated into climate education to address climate-related anxiety and stress. Finally, schools should collaborate with government and health organizations to align educational efforts with broader climate resilience strategies, fostering informed and proactive youth participation.

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Table 1 The knowledge assessment on the health effects of global warming

Score	Percentage	Knowledge Level
12-15	80-100	Good
9-11	60-79	Moderate
<9	<60	Low

Table 2 Assessing risk perception of health effects from global warming

Score	Percentage	Risk Perception Level
40-50	80-100	High
30-39	60-79	Moderate
<30	<60	Low

Table 3 Personal Data of Participants (n=363)

Variable	Number (%)
Gender	
Male	161 (44.35)
Femal	202 (55.65)
Class	
Grade 10	88 (24.24)
Grade 11	146 (40.22)
Grade 12	95 (26.17)
University	34 (9.37)
Residential Location	
Bangkok -inner	78 (21.49)
Bangkok -middle	53 (14.60)
Bangkok -Outer	19 (5.24)
Vicinity provinces	59 (16.25)
Other provinces	154 (42.42)
Living Condition	
With parents	311 (85.68)
With relatives	13 (3.58)
With friends	13 (3.58)
Alone	26 (7.16)
Parent's highest education	
High school	98 (27.00)
Bachelor Degree	127 (34.99)
Master Degree	108 (29.75)
Higher than Master Degree	30 (8.26)

Table 3 Personal Data of Participants (n=363) (continued)

Variable	Number (%)
Household income	
< 20,000	67 (18.46)
20,001-40,000	69 (19.01)
40,001-80,000	65 (17.91)
80,001-150,000	65 (17.91)
> 150,000	97 (26.72)
Chronic health condition	
No	303 (83.47)
Yes	60 (16.53)
Environmental activity participate annually	
Never	117 (32.23)
<3	197 (54.27)
>3	49 (13.50)
Total	363 (100.00)

Table 4 Shows the distribution of awaremess scores regarding the health effects of global warming (n=363)

Number (%)	Score	Awareness Level
297 (81.82)	12-15	Good
33 (9.09)	9-11	Moderate
33 (9.09)	<9	Low

Table 5 Presents the levels of risk perception regarding health effects of global warming (n=363)

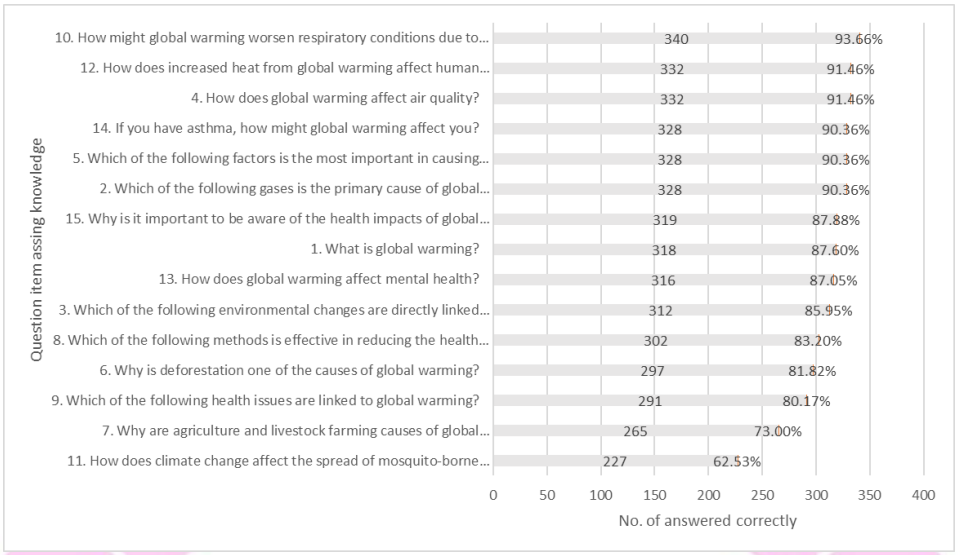
Score	Percentage	Risk perception level
186 (51.24)	40-50	High
149 (41.05)	30-39	Moderate
28 (7.71)	<30	Low

Table 6 Linear Regression Analysis of Predictive Factors for Risk Perception Regarding the Health Effects of Global Warming

Variable	B	Std. Error	Beta	t	Sig.
Gender	2.494	0.835	0.152	2.985	0.003
Class	0.955	0.461	0.107	2.074	0.039
Residential Location	-0.114	0.271	-0.023	-0.42	0.675
Living Condition	-0.916	0.497	-0.095	-1.842	0.066
Parent's Education	-0.877	0.503	-0.1	-1.744	0.082
Household Income	0.947	0.314	0.171	3.016	0.003
Health Chronic Condition	1.012	1.108	0.046	0.913	0.362
No. of Environment Activity yearly	1.284	0.632	0.102	2.032	0.043
Knowledge about health effects of global warming	0.645	0.138	0.238	4.677	0.000

a. Dependent Variable: RScore

Graph 1 The distribution of awareness questions regarding health effect of global warming among participants (n=363)



Graph 2 Risk perception of Health effects of global warming (n=363)